

We claim:

1. Plug and socket means adapted for mating engagement, for establishing electrical communication therebetween in a hazardous environment;

said plug means comprising:

- a) an elongate male member, having a plurality of electrical contacts about an outer periphery thereof;
- b) a resiliently-biased sheath member, slidably biased over said male member so as to substantially cover said electrical contacts on said male member, which upon application of force thereto may be slidably moved so as to uncover said electrical contacts; and
- c) biasing means for biasing said slidable sheath member over said male member;

said socket means comprising:

- a) elongate receptacle means having disposed about an inner periphery thereof a plurality of electrical contacts, said electrical contacts adapted to contact said electrical contacts respectively on said male member when said male member is inserted in said receptacle means;
- b) resiliently-biased protective means displaceable from said receptacle means so as to permit insertion of said male member within said receptacle means; and
- c) biasing means, biasing said protective means so as to prevent ingress of any foreign material into said receptacle means when said male member is not yet inserted in said receptacle means;

wherein said male member is adapted for insertion in said receptacle means upon mating engagement of said plug means with said socket means.

2. The plug and socket means as claimed in claim 1, said resiliently-biased protective means comprising a piston member, slidably-biased within said receptacle means, adapted to substantially cover said electrical contacts disposed on said inner periphery of said receptacle means when said male member is not yet inserted in said receptacle means.
3. The plug and socket means as claimed in claim 2, wherein said piston member is displaceable from within said receptacle means by said male member upon insertion of said male member in said receptacle means.
4. The plug and socket means as claimed in claims 1, 2, or 3;

said socket means further comprising means for contacting said sheath member upon mating engagement of said plug means with said socket means, so as to cause said sheath member to be slidably displaced from a position covering said male member as said male member is inserted in said receptacle means.

5. The plug and socket means as claimed in claim 1, wherein:

said plug means adapted for positioning within an interior of a first drill pipe proximate an end thereof, said end of said drill pipe adapted for mating engagement with a mating end of another drill pipe, and said socket means adapted for positioning within an interior of said another drill pipe proximate said mating end thereof; and

said male member adapted for insertion in said receptacle means upon said first drill pipe being fitted in mating engagement with said another drill pipe.

6. The plug and socket means as claimed in claim 1,

said plurality of electrical contacts disposed about said periphery of said male member comprising first and second plug contacts, electrically coupled to each other via plug-side current direction-limiting means;

said plurality of electrical contacts disposed about said inner periphery of said receptacle means comprising first and second socket contacts, situate in said receptacle means and adapted to correspondingly come into electrical contact respectively with said plug contacts when said plug means is properly and fully matingly engaged with said socket means, said first and second socket contacts electrically coupled to each other via socket-side current direction-limiting means;

at least one additional plug contact and socket contact on each of said plug and socket means, respectively, each similarly adapted to come into electrical contact with each other when said plug means is fully matingly engaged with said socket means;

wherein said plug and socket means are each adapted to be used with circuit isolation means capable of only permitting flow of electrical current through said at least one additional plug and socket contact when current flow through at least one of said plug side and socket side current direction-limiting means is detected.

7. The plug and socket means as claimed in claim 1, wherein said plug and socket means are each rotatable relative to each other.
8. Plug and socket means adapted for positioning within two separate drill pipes and adapted to permit electrical communication between components situated in each of said separate drill pipes and further adapted for mating engagement upon rotatable engagement of said two separate drill pipes with each other;  
said plug means comprising:

- a) an elongate male member, having a plurality of electrical contacts about an outer periphery thereof;
- b). a resiliently-biased sheath member, slidably biased over said male member so as to substantially cover said electrical contacts on said male member, which upon application of force thereto may be slidably moved so as to uncover said electrical contacts; and
- c) biasing means for biasing said slidable sheath member over said male member;

said socket means comprising:

- a) elongate receptacle means having disposed about an inner periphery thereof a plurality of electrical contacts, said electrical contacts adapted to contact said electrical contacts respectively on said male member when said male member is inserted in said receptacle means;
- b) resiliently-biased protective means displaceable from said receptacle means so as to permit insertion of said male member within said receptacle means; and
- c) biasing means, biasing said protective means so as to substantially prevent ingress of foreign material into said receptacle means when said male member is not yet inserted in said receptacle means;

whereby said male member is adapted for insertion in said receptacle means upon mating engagement of said plug means with said socket means.

9. The plug and socket means as claimed in claim 8,

said resiliently-biased protective means comprising a piston member, slidably-biased within said receptacle means, adapted to cover said inner periphery of said receptacle means when said male member is not yet inserted in said receptacle

means.

10. The plug and socket means as claimed in claim 9 wherein said piston member is resiliently biased and is displaceable from within said receptacle means upon insertion of said male member therein.
11. The plug and socket means as claimed in claim 8, 9, or 10 wherein said plug means is rotatable relative to said socket means to permit said socket means to rotate relative to said plug means during rotatable mating engagement of said two separate drill pipes with each other.
12. The plug and socket means as claimed in claims 8, 9, 10, or 11;  
  
said socket means further comprising means for contacting said sheath member upon mating engagement of said plug means with said socket means, so as to cause said sheath member to be slidably displaced from a position covering said male member as said male member is inserted in said receptacle means.
13. The plug and socket means as claimed in claim 8 wherein:  
  
said plug means is adapted for positioning within an interior of a first of said two separate drill pipes proximate an end thereof adapted for mating engagement with a mating end of a second of said two separate drill pipes, and said socket means is adapted for positioning within an interior of said second of said two separate drill pipes proximate said mating end thereof; and  
  
said male member is inserted in said receptacle means upon said first drill pipe being fitted in mating engagement with said second drill pipe.
14. The plug and socket means as claimed in claim 13, further comprising third

biasing means adapted, when said plug means and said socket means are in mated engagement, to exert a force so as to maintain said plug means in mating engagement with said socket means.

15. The plug and socket means as claimed in claim 14,

said socket means contained in a first pressure housing, said first pressure housing attachable to an interior of said first drill pipe;

said plug means contained in a second pressure housing, said second pressure housing positionable within an interior of said second drill pipe;

said second pressure housing slidably moveable within a third pressure housing, said third pressure housing attachable to an interior of said second drill pipe; and

said second pressure housing matingly engageable with said first pressure housing along a common longitudinal axis.

16. The plug and socket means as claimed in claim 15, said second pressure housing having an area of restricted cross-sectional area so as to present a surface area normal to said longitudinal axis of said first and second pressure housing so that ambient pressure within said first and second drill pipes acts on said surface area so as to cause said second housing to be biased in mating engagement with said first housing.

17. The plug and socket means as claimed in claim 14,

said plug means contained in a first pressure housing, said first pressure housing attachable to an interior of said first drill pipe;

said socket means contained in a second pressure housing, said second pressure housing positionable within an interior of said second drill pipe;

said second pressure housing slidably moveable within a third pressure housing, said third pressure housing attachable to an interior of said second drill pipe; and

said second pressure housing matingly engageable with said first pressure housing along a common longitudinal axis.

18. The plug and socket means as claimed in claim 17, said second pressure housing having an area of restricted cross-sectional area so as to present a surface area normal to said longitudinal axis of said first and second pressure housing so that ambient pressure within said first and second drill pipes acts on said surface area so as to cause said second housing to be biased in mating engagement with said first housing.
19. A method for establishing electrical communication between a plug means in a first drill pipe and a socket means in a second drill pipe, comprising the steps of:
  - i) positioning said plug means within an interior of said first drill pipe, proximate to a first end thereof;
  - ii) positing said socket means within an interior of said second drill pipe, proximate to a first end thereof, said first end of said first drill pipe adapted for rotatable engagement with said first end of said second drill pipe;
  - iii) rotatably securing said first end of said first drill pipe to said first end of said second drill pipe, while at the same time simultaneously:
    - a) inserting a male member having a plurality of electrical contacts thereon arranged about an outer periphery and situate within said first drill pipe, into a receptacle means having a plurality of mating electrical contacts thereon arranged about an inner periphery

thereof so that each respective electrical contacts on said male member come into respective contact with said electrical contacts within said receptacle means;

- b) displacing , with said male member, a resiliently biased piston member situate in said receptacle means; and
- c) displacing, with said socket means, a sheath member covering said male member.